(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
17 May 2001 (17.05.2001)

PCT

(10) International Publication Number
WO 01/33991 A1

(51) International Patent Classification[7]: A45D 26/00

(21) International Application Number: PCT/IL00/00732

(22) International Filing Date:
9 November 2000 (09.11.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
132867 11 November 1999 (11.11.1999) IL

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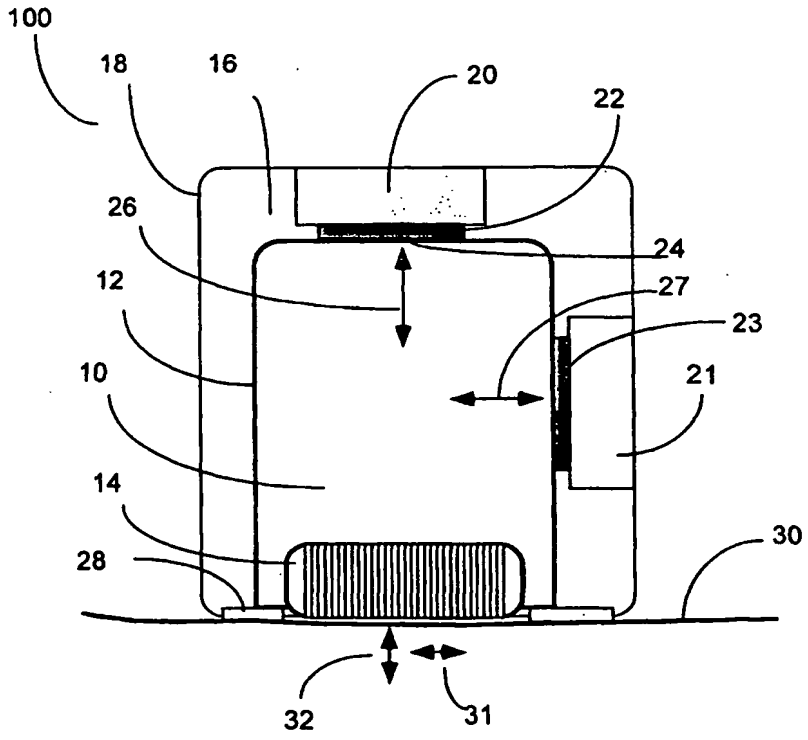
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European

[Continued on next page]

WO 01/33991 A1

(54) Title: EPILATION METHOD AND DEVICE



(57) Abstract: A method and device (100) are presented for improving a hair removal process performed by a hair removal system. A hair to be removed is selected, and vibrations of predetermined frequency, amplitude and power are generated and transmitted to a treatment zone. The vibrations of the treatment zone are maintained for a time sufficient to cause a desired effect at the treatment zone. The desired effect includes at least one of the following effects: loosening, destruction, degeneration or fatigue of at least a part of the treatment zone, and hampering of the morphology or physiology of at least one component of the treatment zone.

patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— *With international search report.*

— *Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

EPILATION METHOD AND DEVICE

FIELD OF THE INVENTION

The present invention is generally in the field of hair epilating techniques, and relates to a device and method for improving a hair removal process performed by a hair removal system.

BACKGROUND OF THE INVENTION

Various hair depilatory devices and methods for the removal of hair are known. Wax-based preparations are used to remove body and facial hair, and include both cold and hot wax preparations.

In recent years, a variety of electrically or manually operated hair depilation devices based on hair plucking have been developed .

U.S. Patent No. 5,908,425 discloses a hand-held, manually operated depilatory device which removes hair located along the length of a linear axis. A string-like elongated element is positioned within the frame, and hair is engaged and captured by the moving twisted engagement of this element and pulled away.

U.S. Patent No. 5,112,341 discloses a hair removal device having a multiple- tweezers element arranged to pluck hair by the plucking motion of a set of movable twist tweezers, which work in a continuously repetitive fashion. Preferably, the hair-plucking element comprises a set of disc-shaped tweezers elements which are in a fixed position, and an interleaved set of disc-shaped movable tweezers elements mounted on a central shaft. The spaces formed between the elements are repetitively opened and closed by the sliding motion of the shaft against a cam which drives the movable elements in both directions in relation to the fixed position tweezers, in order to trap and pluck out hair.

EP 287 976 discloses an epilating appliance having a tweezers arrangement which opens and closes in an oscillating fashion. The tweezers arrangement oscillates in the direction towards and away from the hand-held supporting device, so that the gripping devices are adapted to approach the skin's surface in a spread apart position for receiving the hair. When in the proximity of the skin, these gripping devices are movable to the gripping position in which they clamp the hair, and when in the closed position, the gripping devices withdraw away from the skin, and the hair is thus plucked out in the process. Then, in the range of the retractive position, the gripping devices move again to the spread apart position in which hair is ejected and additional cycles of removal of hair may be initiated.

Examples of such epilating devices are described, for example, in US Patent Nos. 5,7094,935; 5,857,903; 5,899,900; 5,867,908; 5,901,446; US 5,899,900; US 4,940,466; USD 0392412 and the like.

Most prior art depilatory devices are based on the concept of plucking out hair by a single plucking motion, i.e. gripping the hair, and pulling it away from the skin (which pulling may be abrupt or continuous). By this single-plucking technique, the hair shaft is either plucked together with its roots or torn therefrom.

Additionally, most hair removal techniques, including mechanical epilation, the removal of hair by laser, the removal of hair by RF, electrodepilation, microwave epilation etc., involve some amount of pain, tingling or discomfort. To date, the most common means for reducing this discomfort is by the local application of various topical analgesics, by cooling the region to be treated or by performing some sort of gentle massage during the epilation process in order to reduce the pain.

SUMMARY OF THE INVENTION

There is accordingly a need in the art to improve conventional hair epilating techniques by providing a novel device and method capable of being used with any known hair removal system.

It is a major feature of the present invention to provide such a device that, whilst utilizing any known hair removal system, improves its efficiency, expands the longevity of the non-hairy period or decrease hair growth rate following the hair removal process, and reduce pain caused by pulling out hairs and/or destruction of hair roots during the hair removal process.

The main idea of the present invention consists of subjecting a treatment zone to vibrations by using a vibration generator associated with a hair selecting mechanism (e.g., a hair gripping mechanism), therefore vibrating any of, or several parts of the hair, hair follicle or hair supporting element, or the skin around hairs to be treated with epilatory device. The hair selecting mechanism is of a kind enabling selection of a hair to be removed by mechanical gripping of the hair, by affecting the hair by energy transfer, etc., and may be part of a conventional hair removal system. In other words, the vibration generator may be coupled to, installed in or contain a conventional hair removal system. Alternatively, the vibration generator together with the hair selecting mechanism may be a stand-alone device that may and may not be used with another non-mechanical hair removal system. The treatment zone shall include any hair component, skin portion around the hair to be removed, and/or any of the hair supporting elements.

The term ***"hair component"*** used herein signifies the hair root and/or hair shaft, while the term ***"hair supporting element"*** signifies any one of the following: the hair follicle, the papilla, the blood supply to the hair, hair nervation, bulge, as well as the small muscles attached thereto in proximity to the hair root or any other morphological structure or physiological activity which contribute to the vitality of the hair. The term ***"hair removal process"*** used herein signifies a process aimed at reducing degree of attachment of the hair shaft to the hair root, of the hair root to the hair supporting element, and/or of the hair supporting element to its surrounding tissues. This process ends either with the physical plucking of at least a portion of the hair component (e.g., at least a portion of the hair shaft), or with the creation of such condition of the hair attachment or hair vitality to cause its falling out.

According to the invented method, the vibrations at least partly reach the hair shaft, the shaft-root interconnecting zone, the hair root, the hair follicle or its surroundings to cause a desired effect, namely, loosening or destruction, possibly fatigue, of any of these elements or their interconnecting zones. The vibrations can further reach the skin surface, or the basal hair zones, and repeated mechanical vibrations at the skin surface can further alter the threshold of pain, i.e., elevate the threshold of pain, and therefore reduce or eliminate pain caused by the hair removal process. The reduction of pain during plucking might be obtained also by the loosening of the intercellular zone due to the vibrations transferred via the hairs it selves.

The vibration process is preferably carried out concomitantly with the regular hair removal process performed by a hair removal system, which may be of any known kind utilizing mechanical epilation (e.g., a hair gripping device capable of plucking), electroepilation, laser/light epilation, microwave epilation, etc. It should however be noted that the vibration process can also be carried out either before or after the application of any known hair removal process. The introduction of these vibrations provides high efficient, long lasting non hairy period or slower growth rate, and/or markedly reduced pain epilation.

In other words, vibration of the hair, any of its sub-components, or the skin around it may be carried out using virtually any known epilation device together with a vibration enabling means coupled to this device, or installed therein or working in parallel (e.g., where laser-based epilation device is used). This vibration enabling means may utilize acoustic (e.g., transducer), mechanical (e.g., eccentric motor), hydraulic or pneumatic (e.g., piston) means as well as similar devices. These vibrations should be of an appropriate frequency, displacement amplitude, power and duration to cause a desired effect, i.e., improved epilation, longer lasting non hairy period, reduced growth rate and there combination, and preferably also numbing or light anesthesia of the epilation treated zone.

There is thus provided, according to one aspect of the present invention, a method for improving a hair removal process performed by a hair removal system, the method comprising the steps of:

(a) selecting a hair to be removed;

(b) generating vibrations having predetermined frequency, amplitude and power, and transmitting said vibrations to a treatment zone;

(c) maintaining said vibrations of the treatment zone for a time sufficient to cause a desired effect at the treatment zone.

As indicated above, the desired effect consists of improving the epilation process, prolonging its effect, reducing further hair growth rate and/or numbing, or partial numbing, of the treatment zone.

The hair selection may be performed by utilizing a mechanical hair removal system having an effective epilating compartment, composed, for example, of rotating disks or spring, capable of gripping the hair. The frequency of the vibrations is preferably higher than the operational frequency of the hair removal system (i.e., its active epilating compartment) by at least one order of magnitude, e.g., when a mechanical epilation device of 100 or 600Hz frequency is used, the frequency of the vibrations should preferably be at least 1000 or 6000Hz respectively. The vibrations of a stand-alone type device (i.e., an independent device formed of the vibration generator and the hair gripping mechanism, whose operation is irrespective of the operation of any other hair removal system, if used) are typically with the frequency in a range from 10Hz to 100kHz, and preferably in the frequency range of 50Hz to 10kHz, and most preferably in the range of 100Hz to 1000Hz. The amplitude should preferably be above 50μm. It should, however, be noted that tradeoff of parameters exists, e.g., when higher frequency is used, compensation can be done concerning the amplitude, etc.

As for the duration of the vibration transmission, it preferably does not exceed the duration of the epilation process performed by the hair removal system (i.e., is either shorter, or substantially equal thereto). This period of time actually depends on the desired effect. In the case of a stand-alone type device, the

vibrations are transmitted during the time period of second-parts till seconds. The minimum supply power required to achieve the desired effect is preferably in the range of single Watts or Watt parts.

Thus, the vibrations may be transmitted to the treatment zone immediately before, during or after the hair removal process carried out by the hair removal system, but preferably concomitantly with the hair removal process.

According to another aspect of the present invention, there is provided a device for improving a hair removal process performed by a hair removal system, the device comprising a hair selecting means for affecting the hair to be removed, and a vibration generator that generates vibrations having predetermined frequency, amplitude and power, and transmits said vibrations to a treatment zone, such as to cause a desired effect at the treatment zone.

As indicated above, the hair gripping means may and may not be part of a hair removal system. This is relevant for such cases when the epilation device according to the invention is to be used with the conventional mechanical hair removal system. However, should the invented device be used for instance with a laser or microwaves based epilation system, which do not have means for gripping hairs, the device according to the invention is capable of gripping hairs with its own hair gripping means.

Thus, according to yet another aspect of the present invention, there is provided a vibration generator engageable with a mechanical hair removal system, having a hair gripping means and an effective epilation compartment, the vibration generator being capable of generating vibrations of predetermined frequency, amplitude and power, and transmitting said vibrations towards a treatment zone, so as to cause a desired effect at the treatment zone.

The hair removal systems suitable to be used in the epilation device according to the invention may include mechanical epilators and shavers, RF hair removals, electroepilation devices, microwave epilation, laser or light epilatory devices, etc. Such hair removal systems may, for example, be those developed by

Braun, Philips Corporation, Remington Corporation, disclosed in the above prior art patents.

The vibration generator comprises at least one vibration element, and optionally, at least one transmitting unit. The vibration element may be of any known suitable kind utilizing, for example, as acoustic (e.g., transducer), mechanical (e.g., eccentric motor), hydraulic or pneumatic (e.g., piston) means, etc.

When using the vibration generator with the mechanical hair removal system, the operation of the vibration generator preferably causes vibrations of at least the active compartment of the hair removal system, or of its close proximity. These vibrations are transferred to the shaft of the treated hair, and further to the other hair components to create the desired effect.

The effective epilation compartment of the mechanical hair removal system may be of a kind comprising spaced-apart parallel rotation disks, the spaces or gaps between the adjacent disks serving for trapping of hairs therein, thereby enabling clamping of the hairs. The disk's rotation after clamping the hair causes plucking of the hair shaft, or entire hair, out of the follicle. According to the present invention, the trapped hair is subjected to vibrations, prior to and/or whilst being plucked, using the vibration generator. To this end, the vibration generator preferably causes vibrations of at least the effective component of the plucking device, and further causes vibrations of the clamped hair. In other words, the hair is vibrated during the process of clamping the hair between the disks, and is further vibrated, whilst being clamped. This may significantly enhance the efficiency of the hair removal process, and concomitantly reduce pain caused by the effects of clamping and plucking.

Due to the vibrations applied to the treatment zone, plucking itself is easier and less painful, owing to the initial loosening of zones between the treated hair and its surroundings. Furthermore, the unplucked hair components suffer from further additional damage resulting from the repeated vibration, delaying the hair recovery and re-growth, resulting in the longevity of the non-hairy period or slower growth rate. At the same time, in addition to the reduction of pain associated with the loosening of the hair surroundings, also the repeated vibrations at the skin

surface increase the threshold of pain, further contributing to a less painful procedure

Preferably, the hair is plucked with the hair removal device, during, or after the transmission of the vibrations to the hair.

The vibration process is carried out for sufficient time to cause loosening or destruction, e.g., enlargement of intercellular spaces or fatigue respectively, of any or several of the vibrated hair components, or areas adjacent to the vibrated components. Vibration of the effective compartment of the hair removal system, during and in addition to its regular operation, further improves the efficiency of the hair plucking due to loosening of tissue and/or fatigue associated with the pre-plucking periodic vibration of the treated hair. It further weakens the hair-root, the root-follicle or the follicle-dermal connection, together with other degenerative effects, thereby enabling easier and longer lasting hair epilation with the hair removal system. The effect of the repeated vibration might be further attributed to heating, possible cavitation and denaturation or potential ablation. In addition, the repeated high frequency vibration, having the appropriate characteristics, reach the skin surface, either directly or via the hair shafts, and cause anesthesia/numbing of the skin surface (treatment zone). Preferably, vibrations are transmitted in a direction along the long axis of the hair, to omit losses at interface with the skin.

The desired effect (efficient, long lasting as well as pain reduced hair removal process and slower growth rate) can be carried out using one of the following implementations of the device:

A. Both, the vibration generator and the hair removal system are installed in a common vibrating housing.

In this case, the transmission of the vibrations through the housing causes vibrations of the entire hair removal system. thereby enabling desired vibrations of at least the hair trapped by this hair removal system. During this operation, the vibrations might further reach and affect the skin surface, thereby also elevating the threshold of pain. In this specific implementation of the device, the desired effect can be also achieved by vibrating a rim-like zone around the hair removal system at

an area adjacent to the treatment zone. Similar phenomena could be achieved by the vibrations transmitted via hairs to affect nerves.

B. The vibration generator is installed in the hair removal system.

This enables to vibrate the effective epilation component of the hair removal system attached to the skin. Here, hairs are vibrated after being trapped and before being removed (e.g., plucked out of the skin), and this vibration may affect also the skin surrounding the treated hairs.

C. The vibration generator is an auxiliary unit.

In this case, the vibration of hairs is carried out independently of the hair removal system. The vibration generator itself is provided with a suitable hair selecting means for affecting (e.g., gripping) the selected hair and providing its vibration, preferably without any active mechanical epilation process. An example for this way of operation might be a laser epilation treatment accompanied by the operation of the device according to the invention.

Occasionally, pretreatment of the hairs to be treated or the skin might be required, for instance stretching the skin or cleaning the skin surface to reduce absorption of the mechanical energy in the skin. The procedure of vibration itself is preferably performed on tensioned hairs, and therefore another pretreatment to be performed might consist of adding gels to tension the hairs or gripping and slightly pulling the hairs to give them some tension.

Occasionally, the same unit used to activate the epilating part of the epilation device can be used also to vibrate the epilating part of the said epilation device (using appropriate transmission parts), i.e., without installment of further mechanical means for vibration, but only certain additives. For instance, a motor used to cause rotation of the active part of the epilation device to initiate plucking of hairs. can be used utilizing for example an eccentric component, also to vibrate the active part, and thereby to increase the efficiency and longevity of epilation as well as to sedate/reduce pain caused by the epilation process. However, when a hair removal system having no mechanical vibration means is used, implementation of a vibration-enabling means is required.

The case may be such that, during a part of the epilation process or during the entire process, a vibrating component of the epilation device should be at least partially isolated from the skin. For this purpose, the epilation device may be formed with a spacer to be appropriately located between the vibrating component and the patient's skin, when putting the device in operation (i.e., applying the activated device to the skin). The spacer does not affect the gripping or the actual vibration of the hair, but serves as a buffer preventing vibrations of the vibrating component from reaching the skin, yet allowing them to run via the hairs. Such a spacer can be used also to grip hairs.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the invention and to see how it may be carried out in practice, a preferred embodiment will now be described, by way of a non-limiting example only, with reference to the accompanying drawings, in which:

Figs. 1 and 2 are schematic illustrations of two different examples of an epilation device according to the invention aimed at increasing efficiency of the epilation process, and decreasing pain utilizing a mechanical hair gripping or hair removal device installed in a vibration generator;

Fig. 3 is a schematic illustration of an epilation device according to the invention, utilizing a mechanical hair gripping or hair removal device, with a vibration generator installed therein;

Figs. 4A to 4D schematically illustrate the main components of an epilation device according to the invention, utilizing an electro-epilation system associated with a vibration generator;

Fig. 5 is a schematic illustration of an epilation device according to the invention, utilizing a laser/light epilation device associated with a vibration generator;

Fig. 6 is a schematic illustration of an epilation device according to the invention, utilizing an RF epilation device associated with a vibration generator;

Figs. 7A to 7D schematically illustrate an improved spring-based epilation device according to the invention;

Figs. 8A to 8F schematically illustrate an epilation device according to the *"hair disconnecting aspect"* of the invention;

Fig. 9 is a schematic illustration of one more embodiment of an epilation device according to the invention;

Figs. 10A and 10B schematically illustrate a hair removal device according to the invention, in two different operational positions of its gripping device, respectively; and

Figs. 11A-11F schematically illustrate a hair gripping and skin stretching device according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Fig. 1, there is illustrated an epilation device **100** constructed and operated according to one embodiment of the invention, aimed at increasing the efficiency of the hair removal process. The device **100** comprises such main constructional parts as a hair gripping device **10** (constituting a hair selecting means for affecting a selected hair to be removed) and a vibration generator **16**. The hair gripping device may be of any known kind typically formed with an effective epilating compartment **14** accommodated in a housing **12** with a portion of the compartment projecting from the housing towards skin **30**. It should be noted that the device **10** could be any mechanical hair removal device, for example those commercially available from Philips, Braun etc.

The vibration generator **16** is engageable with the hair gripping device **10**. To this end, a housing **18** of the vibration generator **16** may be formed with a groove (not shown) shaped and dimensioned so as to enable the mounting of the housing **12** in the groove.

The vibration generator **16** is composed of at least one vibration element – two vibration elements **20** and **21** being shown in the present example. These vibration elements transmit vibrations to the hair gripping device **10** (or hair

removal device) to cause its vibrations along corresponding axes, shown as arrows **26** and **27**, respectively. It should, however, be noted that the provision of the second vibration element, e.g., the element **21**, is optional.

As further shown in the figure, transmission units **22** and **23** are provided for transmitting vibrations from the elements **20** and **21**, respectively, to the hair gripping or hair removal device **10**. However, the provision of these transmission units is optional, and the vibrations may be transmitted directly from the elements **20** to the hair gripping device **10** via an attachment zone **24** (and that associated with the element **21**, as the case may be).

Further provided in the device **100** is a vibration absorber **28** attachable to the skin **30**, so as to absorb vibrations of the housing **18** during the operation of the apparatus **100**. The absorber **28** is preferably located at the interface between the housing **18** and the hair gripping device **10**.

When the device **100** is put in operation, the vibrations generated by the element **20** and/or element **21** are transmitted through the device **100**. The transmitted vibrations concomitantly affect all parts of the entire epilation device **100**, including its active epilating compartment **14** and the housing **18** of the vibration generator. The vibrations of the compartment **14** are at least partly transferred to hairs (not shown) in the direction marked as arrows **32** and **31** (corresponding, respectively, to the elements **20** and **21**). These affected hairs are those which are gripped by the compartment **14** during the regular epilation process. As for the vibrations of the housing **18**, they are absorbed in the vibration absorber **28**. The provision of two vibration elements **20** and **21**, if put together, causes the vibrations of the compartment **14** in two mutually perpendicular directions **32** and **31**, thereby enhancing its movement.

Fig. 2 illustrates an epilation device **200**, which, similarly to the previous example of Fig. 1, is aimed at reducing pain caused by the epilation process. The device **200** is constructed generally similar to the device **100** of Fig. 1, but differs

therefrom in that its effective epilating compartment is only partly vibrated by a vibration generator.

Thus, the device **200** comprises a hair gripping device (or a mechanical device for hair removal) **35**, which may be of any known kind (e.g., the same device **10** of Fig. 1 can be used), and a vibration generator **41**. The hair gripping device **35** is composed of a housing **37** carrying an active epilating compartment **39**. To provide appropriate engagement between the hair gripping device **35** and the vibration generator **41**, a housing **43** of the vibration generator **41** may be formed with a groove, which is not specifically shown. A vibration element **45**, which is attached to the housing **43** thereinside, generates vibrations and transmits them towards the hair gripping device **35**, either directly or via a transmission unit **47**.

According to the present example, a guiding unit **49** in the form of arms or plates is located inside the housing **43** being interposed between the vibration element **45** (or transmission unit **47**, as the case may be) and the housing **37** of the hair gripping device **35**. Preferably, the arms or plates **49** surround the hair gripping device **35**. The transmitted vibrations are guided by the unit **49** towards its lower portion **51** that further transfers the vibrations in the direction shown by arrows **57** . These vibrations affect the portion of skin **55** within the zones **53** of direct contact between the device **200** and the skin. These zones preferably form a rim surrounding the hair gripping device **35**, and the active epilating compartment **39** of the device **35** thereby always passes an area previously sedatively treated, i.e., an area similar to that defined by the zones **53**.

Reference is now made to Fig. 3, illustrating an epilation device **300** utilizing a hair gripping device with a vibration generator installed therein. The hair gripping device may be of any known kind, including an effective epilation compartment **64** and a driving compartment **60** (containing for instance all electronic circuits required for the device operation) which are accommodated in a common housing **62**. The vibration generator is composed of two vibration elements **68** and **69** (the provision of only one of them being sufficient for the

device operation), associated with transmission units **72** and **73** (whose provision is optional) and supported inside the housing **62** by supporting elements **70** and **71**, respectively. Vibrations generated and transmitted by the vibration elements **68** and 69 are transmitted to the compartment **64** via a further transmission unit **74**, which may be part of the original hair gripping or hair removal device. The vibrations reaching the compartment **64** cause its movement in two mutually perpendicular directions, shown as arrows **76** and **77**. As shown, the device **300** also comprises buffers or spacers **79** interposed between the bottom side of the housing **62** and skin **66** in a manner to surround the active compartment **64**.

The above-described devices **100**, **200** and **300** exemplify the epilation devices aimed at improving a conventional mechanical epilation device (hair gripping device and/or hair removal device) by providing it with a vibration generator, which can either be coupled to the hair gripping device or be integral therewith.

Turning now to Figs. 4A-4D, an epilation device **400** is illustrated, which utilizes an electro-epilation system (rather than a mechanical epilation system) and a vibration generator. The electro-epilation system might be of a known kind, composed of an electro-epilation needle **180** mounted within a central slot of a cylindrically shaped housing **190** and supported by support elements **191**. The needle **180** is by its distal end **182** insertable into a hair follicle **184** towards the hair root 188.

Figs. 4A and 4C illustrate, respectively, a front-section view and a top-section view (taken along line I-I) of the device **400** in its initial, ready to hair removal position. Figs. 4B and 4D illustrate, respectively, a front-section view and a top-section view (taken along line II-II) of the device **400** in its operative position, the needle **180** being inserted into the hair follicle **184**, the hair shaft **181** being trapped.

The vibration generator is composed of a vibration element 189 , such as acoustic transducer, coupled to a vibrating element 196 (optionally, via a transmission unit **195**) extending towards a skin surface **186** and serving also for

transmitting vibrations to the skin surface **186**. As shown, the element **192** is substantially of an annular shape surrounding the needle portion **180** and defining an annular space **193** therebetween for a hair shaft **181** to be inserted therein and gripped by gripping arms **192**. The latter, when in inoperative position thereof (without gripping hairs), are movable within an outer margin of a gripping area defined by an annular space **194** between the inner wall of the housing **190** and the outer wall of the vibrating element **196**. The needle **180** and the vibration generator (vibration element **189**) are coupled to a power source (not shown) through wires **197** to be electrically supplied.

When the needle (by its distal end **182**) is inserted into the follicle **184** (Fig. 4B), the vibrations generated and transmitted by the vibration generator reach the skin surface **186** thereby performing a massage of the skin surface in the direction along the axis of vibration shown by arrows **198**. This massage effect reduces pain caused by the hair gripping procedure. The vibrations are also transmitted to the hair root **188** causing its movement in the direction along the axis of hair vibration, shown as arrow **199**. This increases intra-follicular alterations and facilitates the hair removal.

Fig. 5 illustrates an epilation device **500** utilizing the principles of light/laser epilation. The device **500** comprises a light source (not shown) generating a plurality of light beams, generally at **92**, and directing them onto a skin surface **94**. Irradiated beams **92** might also be microwaves. A vibration generator is composed of a vibrating element **80**, such as acoustic transducer, and a transmission unit **82**, for example in the form of an acoustic horn and tip. Mounted on the distal end of the tip is a gripping element **84**. That portion of the device which is brought into direct contact with the skin surface **94** is formed with a spacer or buffer element **86** aimed at preventing the transmitted radiation, e.g., acoustic waves, from reaching the skin surface. The transmission unit **82**, gripping element **84** and buffer element **86** could be made of a material transparent for the incident light (or the incident microwaves, as the case may be). During the operation of the device, the hair shaft

87 is gripped by the element **84**, and the vibrations of this element are transmitted to the hair root **88** and papillae **90**. The repeated vibrations facilitate the thermal effect caused by the irradiated light or microwaves.

Fig. 6 illustrates the main components of an epilation device **600** utilizing RF radiation. The device **600** comprises a tweezers **112**, covered by isolation **114**, with pivotal arms about an axis **110**. Front sides **106** and **108** of the tweezers arms **112** define opposite walls **102** and **103**, respectively, of a hair holding compartment.

A vibration generator is accommodated in a handle of the device formed with an insulation cover **120**, and is composed of a vibrating element **118** (e.g., as acoustic transducer) coupled to the original source of an RF transmitting unit **116**, and supported by a support element **124**, and a further transmission unit **122** that transmits both the RF signals and vibrations. The leading edge of the tweezers intended to be brought in contact with skin is formed with a buffer element **104**. According to this specific example, a hair shaft (not shown) located between the opposite walls **102** and **103** is affected by the vibrations, in addition to the RF effect, if any, to facilitate the hair removal process.

Following are some more examples of epilation devices whose operation can be significantly improved by providing them with a vibration generator according to the invention.

Figs. 7A-7D illustrate a spring-based epilation device **700**. Figs. 13A and 13B are bottom views of two different implementations of the device, with and without the use of a buffering spacer **134**, respectively, to contact a skin surface **140**. To facilitate understanding, the same reference numbers are used for identifying those components, which are common in these two examples. Figs. 7C and 7D are section views of the devices of Figs. 7A and 7B, respectively, taken along the lines I-I and II-II (of Figs. 7A and 7B respectively).

The main constructional and operational principles of the spring-based epilation device are known *per se* and therefore need not be specifically described, except to note the following. A spring **132** is held by an appropriately designed flat tip **130** having its end portion **135**. The spring **132** is preferably round, and is

pressed within the mould of tip. For the purposes of the present invention, the device **700** is formed with a screw area **136** to be attached to a horn (not shown). However, the element **136** might also be an acoustic transducer.

Figs. 8A-8F illustrate an epilation device **800** according to another embodiment of the invention. Figs. 8A and 8B are bottom views of the device, showing two different operative positions of the device with discs **154** being opened and closed, respectively. Figs. 8C and 8D are side views of the device **800** corresponding to the positions of Figs. 8A and 8B. Figs. 8E and 8F more specifically illustrate the discs **154** in their opened and closed positions, respectively.

As shown, the discs **154** are arranged in a spaced-apart parallel relationship and are associated with a flat disc runner **152** that keeps the discs in the correct orientation. During the operation of the device, a hair **162** becomes inserted into the space between two adjacent discs **154** in their opened position, and shifting of the discs into their closed position results in the gripping of the hair **162** by the discs. The construction and operation of such a discs-based hair gripping device are also known *per se* and need not be more specifically described.

The device **800** is provided with a spacing layer **150** in zones of direct contact of the device with a skin surface **160**. An appropriately designed flat tip **156** or other vibration conducting element holds the discs **154**, and is formed with a screw member **158** for coupling the tip to a horn of a vibration generator, which is not specifically shown. The provision of the screw member **158** is optional and it can be replaced by a transducer directly attached to the vibration conducting element **156**. However, the member **158** might also be an acoustic transducer. Further optionally provided in the device **800** is a side transducer **164** that operates the opening and closing of the discs **154**, and further provides actual vibration of the trapped hairs **162**. The entire system **800** is isolated from the skin **160** by the vibration buffers **150**.

Fig. 9 illustrates an epilation device **900** having a clip member **202** activated by a spring **200** for pivotal movement about an axis **206** with respect to a tip element **204**. The distal end of the clip **202** is formed with a gripping part **208** projecting from the clip **202** towards the tip **204**. The clip member **202** is shiftable between its normally closed position and opened position against the tension of the spring **200**. In the opened position of the clip member, a hair shaft **216** can be inserted into a space between the gripping part **208** and the tip **204**. When the clip member **202** is shifted into its closed position, the gripping part becomes retracted towards the tip **204** thereby clamping the hair shaft **216** between the clip and tip.

It should be noted that the clip member **202** could be located on an "envelope" not touching the tip end. The gripping part **208** is made of a material having special characteristics enabling the fastening of the hair and vibration of at least a portion of the clip together with the tip. In other words, the clip is sufficiently firm to grasp the hair, while being sufficiently flexible to enable its vibration with the tip.

A spacing layer **210** is provided within the zone of direct contact of the device with a skin surface **217**. When the hair shaft **216** is fastened by the clip and tip, the vibrations of these parts are transferred to the hair bulb **212**, thereby creating effect at the desired location and facilitating aspects of the hair removal from papillae **214**.

Figs. 10A and 10B illustrate a device **1000** for hair removal in two different operational position of its gripping unit, respectively. The gripping unit is composed of a tip **220** and a strong leaf spring **222**. The spring **222** is connected to the tip **220** via a surface **224** of a direct part **226** of the spring. Two wings **228** and **230** of the spring are flexible, and are shiftable between their opened position (Fig. 10A) and closed position (Fig. 10B) by rotation of prism **238** about an axis **236**. During the operation of the device, the spring **222** does not contact the prism **238** due to air gap **240** surrounding the prism. Distal parts **232** and **234** of the wings **228** and **230**, respectively, are intended to catch hair **244** (Fig. 10B). An outer sleeve

242 prevents the hands of an individual (a medic, cosmetician, etc) from touching the vibrating tip **220**.

As illustrated in Fig. 10B, the rotation of the prism **238** causes enlargement of the space between the wings **228** and **230**. Accordingly, the distance between the distal parts **232** and **234** is increased, thereby enabling the entrance of the hair shaft **244** into the space between the wings' ends. Further rotation of the prism **238** results in the closing of the wings and gripping of the hair or hairs to be treated.

It should be noted that the gripping device could utilize two brushes movable along an axis. The gripping device can be used as a stand-alone hair removal device, or in combination with other hair removal devices utilizing any suitable hair removal technique.

Figs. 11A-11F schematically illustrate a hair gripping and skin stretching device **1100** constructed and operated according to the invention. Figs. 11A and 11D showing, respectively a cross-sectional view and a bottom view of the device, correspond to an inoperative position of the device. Figs. 11B and 11E show, respectively, a cross-sectional view and a bottom view of the device **1100** at its initial operational stage. Figs. 11C and 11F demonstrate the device **1100** during vibrating, by e.g., sonication, of hair **1024**.

The device **1100** comprises a tip **1002** formed with preferably equally spaced grooves **1010** and arms **1004**, and has a central groove **1020** for receiving the hair **1024** therein. Each groove **1010** contains a corresponding one of skin-stretching legs **1006**, whose distal end is formed with a legs-attachment disk **1008**. The arms **1004** are displaceable between their opened and closed positions. The opening of the arms **1004** causes a downward movement of the legs **1006** along the axes of the grooves **1010** towards a skin **1022**, which movement is limited by stoppers **1012** installed in the preferably equally spaced grooves **1010**.

As shown in Figs. 11A and 11D, in the inoperative position of the device, the tip **1002** is not brought in contact with the hair **1024**. The skin-stretching legs **1006** are in their retracted, upper position in the grooves **1010**, the legs-attachment disks **1008** not touching the skin surface **1022**. At this position, the arms **1004** are

located close to each other, and the central groove **1020** is rather closed. The stoppers **1012** do not affect the legs **1008**.

As shown in Figs. 11B and 11E, when the device **1100** is put in operation, the arms **1004** of the tip **1002** are shifted into their opened position. Simultaneously with the opening of the arms **1004**, the legs **1006** moves downward into their projected position controlled by the stoppers **1012**. The central groove **1020** becomes larger so as to harbor the hair **1024** attached to the skin **1022**. Comparing the position shown in Fig. 11E to that of Fig. 11D, it is clear that the movement of the arms **1006** with the disks **1008** attached to the skin **1022** stretches the skin.

As shown in Figs. 11C and 11F, further displacement of the arms **1004** (with the hair **1024** located therebetween) into their closed position, results in the closing of the central groove **1020** so as to grip/trap the hair **1024**. In this position of the device, the legs **1006** carrying the disks **1008** are locked by the stopper **1012**. It should be understood, although not specifically shown, that during this process of closing the arms **1004**, the distance between the end of the tip **1002** and the skin **1022** becomes larger, thereby enforcing tension on the gripped hair **1024**. The legs **1006**, which stretch the skin zone around the hair **1024**, are prevented from being retracted back into the grooves **1010** by the stoppers **1012**.

Those skilled in the art will readily appreciate that various modifications and changes can be applied to the preferred embodiment of the invention as hereinbefore exemplified without departing from its scope defined in and by the appended claims.

In the method claims that follow, alphabetic characters used to designate claim steps are provided for convenience only and do not imply any particular order of performing the steps.

CLAIMS:

1. A method for improving a hair removal process performed by a hair removal system, the method comprising the steps of:

(a) selecting a hair to be removed;

(b) generating vibrations having predetermined frequency, amplitude and power, and transmitting said vibrations to a treatment zone;

(c) maintaining said vibrations of the treatment zone for a time sufficient to cause a desired effect at the treatment zone.

2. The method according to Claim 1, wherein the selection of the hair to be removed is performed by mechanical gripping of said hair.

3. The method according to Claim 1, wherein said treatment zone includes at least one of the following list: any hair component, any of the hair supporting elements, a skin portion around the hair to be removed, and any morphological structure which contribute to the vitality of the hair.

4. The method according to Claim 1, wherein said desired effect includes at least one of the following effects: loosening, destruction, degeneration or fatigue of at least a part of the treatment zone, and hampering of the morphology or physiology of at least one component of the treatment zone.

5. The method according to Claim 1, wherein said desired effect is reduction of pain caused by a hair removal process.

6. The method according to Claim 1, and also comprising the step of removing the hair.

7. The method according to Claim 6, wherein said step of removing the hair is performed after applying said vibrations to the treatment zone.

8. The method according to Claim 6, wherein said step of removing the hair is performed simultaneously with the vibrations to the treatment zone.

9. The method according to Claim 6, wherein the step of removing the hair comprises generation and transmission of radiation.

10. The method according to Claim 9, wherein said generation and transmission of radiation utilizes affecting the hair by RF radiation.

11. The method according to Claim 6, wherein the step of removing the hair utilizes an electro-epilation process.

12. The method according to Claim 9, wherein said generation and transmission of radiation utilizes an application of microwave energy.

13. The method according to Claim 9, wherein said generation and transmission of radiation utilizes an application of light energy.

14. The method according to Claim 12 or 13, wherein said step of removing the hair is performed prior to the transmission of the vibrations to the treatment zone.

15. The method according to Claim 6, wherein the step of removing the hair utilizes mechanical plucking thereof.

16. The method according to Claim 1, wherein said predetermined amplitude is substantially more than 50 microns.

17. The method according to Claim 1, wherein said predetermined frequency is in a range of 10Hz to 100kHz.

18. The method according to Claim 15, wherein said mechanical plucking is performed by a mechanical hair removing system, said predetermined frequency preferably being 10 times higher then an operational frequency of the hair removing system.

19. The method according to Claim 1, wherein said time sufficient to cause the desired effect is preferably from second parts till seconds.

20. The method according to Claim 1, and also comprising the step of stretching a skin portion in the vicinity of the treatment zone.

21. The method according to Claim 1, and also comprising the step of treatment of the hair performed prior to or concurrently with the transmission of said vibrations to the treatment zone.

22. The method according to Claim 21, wherein said treatment comprises tensioning of the hair.

23. A device for improving a hair removal process performed with a hair removal system, the device comprising a hair selecting means for affecting a selected hair to be removed, and a vibration generator that generates vibrations

having predetermined frequency, amplitude and power, and transmits said vibrations for sufficient time to a treatment zone, such as to cause a desired effect at the treatment zone.

24. The device according to Claim 23, wherein said treatment zone includes at least one of the following list: any hair component, any of the hair supporting elements, and a skin portion around the hair to be removed, and any morphological structure which contribute to the vitality of the hair.

25. The device according to Claim 23, wherein said desired effect includes at least one of the following effects: loosening, destruction, degeneration or fatigue of at least a part of the treatment zone, and hampering of the morphology or physiology of at least one component of the treatment zone.

26. The device according to Claim 22, wherein said desired effect is reduction of pain caused by said hair removal process.

27. The device according to Claim 23, wherein said vibration generator is engageable with the hair selecting means associated with an effective epilation compartment capable of performing the hair removal process.

28. The device according to Claim 27, wherein said hair selecting means includes a hair gripping device.

29. The device according to Claim 28, wherein said hair gripping device with the effective epilation compartment form together a mechanical hair removal system.

30. The device according to Claim 29, wherein said vibration generator is accommodated in a housing capable of engaging said mechanical hair removal system.

31. The device according to Claim 30, and also comprising a vibration absorber element that at least partly absorbs the vibrations of said housing.

32. The device according to Claim 29, wherein said vibration generator is integral with the mechanical hair removal system.

33. The device according to Claim 23, and also comprising said hair removal system.

34. The device according to Claim 23, wherein said hair removal system comprises radiation generation and transmission means.

35. The device according to Claim 34, wherein said radiation generation and transmission means comprises an RF means.

36. The device according to Claim 35, wherein said vibration generator is coupled to the RF transmitting unit.

37. The device according to Claim 33, wherein said hair removal system comprises an electro-epilation means.

38. The device according to Claim 34, wherein said radiation generation and transmission means comprises microwave energy generating and transmitting means.

39. The device according to Claim 34, wherein said radiation generation and transmission means comprises light energy generating and transmitting means.

40. The device according to Claim 34, wherein said radiation generation and transmission means comprises ultrasound energy generating and transmitting means.

41. The device according to Claim 28, wherein said hair gripping device comprises tweezers arms pivotal between their opened and closed position to receive and clamp the hair therebetween.

42. The device according to Claim 28, wherein said hair gripping device comprises spaced-apart parallel disks shiftable between their opened position, in which the space between the adjacent disks serves for trapping the hair, and their closed position, in which the hair is clamped by the disks.

43. The device according to Claim 28, wherein said hair gripping device comprises a tip-like element associated with the vibration generator, and a clip-like element coupled to the tip via a spring, the clip being shiftable between its closed and opened position with respect to the tip against the tension of the spring.

44. The device according to Claim 28, wherein the hair gripping device comprises a strong leaf spring connected to a tip of the vibration generator, the

spring wings being flexible and shiftable between their opened and closed positions.

45. The device according to Claim 28, wherein the hair gripping device is integral with the vibration generator, the device comprising a tip formed with spaced-apart grooves and arms, and a skin stretching means mounted for sliding movement along the grooves, displacement of the arms between their opened and closed positions enabling the hair to be clamped in a central groove and causing a downward movement of the skin stretching means towards the skin.

46. A vibration generator engageable with a mechanical hair removal system, that has a hair gripping means and an effective epilation compartment and is capable of performing a hair removal process, wherein the vibration generator is capable of generating vibrations of predetermined frequency, amplitude and power, and transmitting said vibrations towards a treatment zone, such as to cause a desired effect at the treatment zone.

47. The vibration generator according to Claim 46, wherein said treatment zone includes at least one of the following list: any hair component, any of the hair supporting elements, and a skin portion around the hair to be removed, and any morphological structure which contribute to the vitality of the hair.

48. The vibration generator according to Claim 46, wherein said desired effect includes at least one of the following effects: loosening, destruction, degeneration or fatigue of at least a part of the treatment zone, and hampering of the morphology or physiology of at least one component of the treatment zone.

49. The vibration generator according to Claim 46, wherein said desired effect is reduction of pain caused by said hair removal process.

50. The vibration generator according to Claim 46, wherein said hair gripping means comprises tweezers arms pivotal between their opened and closed position to receive and clamp the hair therebetween.

51. The vibration generator according to Claim 46, wherein said hair gripping means comprises spaced-apart parallel disks shiftable between their opened

position, in which the space between the adjacent disks serves for trapping the hair, and their closed position, in which the hair is clamped by the disks.

52. The vibration generator according to Claim 46, wherein said hair gripping means comprises a tip-like element associated with the vibration generator, and a clip-like element coupled to the tip via a spring, the clip being shiftable between its closed and opened position with respect to the tip against the tension of the spring.

53. The vibration generator according to Claim 46, wherein the hair gripping means comprises a strong leaf spring connected to a tip of the vibration generator, the spring wings being flexible and shiftable between their opened and closed positions.

54. The vibration generator according to Claim 46, wherein the hair gripping means is integral with the vibration generator, the device comprising a tip formed with spaced-apart grooves and arms, and a skin stretching means mounted for sliding movement along the grooves, displacement of the arms between their opened and closed positions enabling the hair to be clamped in a central groove and causing a downward movement of the skin stretching means towards the skin.

55. A method for decreasing the amount of pain sensed from a skin from which hair is to be removed, the method comprising the steps of generating vibrations of predetermined frequency, amplitude and power and transmitting said vibrations towards the skin during a sufficient time period such as to cause at least partial numbing of the pain sensed from the skin.

56. A device for decreasing the amount of pain sensed from a skin from which hair is to be removed, the device comprising a vibration generator, generating vibrations of predetermined frequency, amplitude and power, and coupled to a skin-contacting member for transmitting said vibrations towards the skin such as to cause at least partial numbing of the pain sensed from the skin.

57. The device according to Claim 56, and also comprising a hair treatment means for treatment of the hair prior to or concurrently with the transmission of said vibrations towards the skin.

58. The device according to Claim 57, wherein said hair treatment means comprises tensioning means for tensioning the hair.

59. The device according to Claim 58, wherein said tensioning means comprises gels.

60. The device according to Claim 56, and also comprising a skin treatment means for treatment of the skin prior to or concurrently with the transmission of said vibrations towards the skin.

61. The device according to Claim 60, wherein said skin treatment means comprises stretching means for stretching the skin to reduce absorption of mechanical energy in the skin.

62. The device according to Claim 60, wherein said skin treatment means comprises cleaning means for cleaning the skin surface to reduce absorption of mechanical energy in the skin.

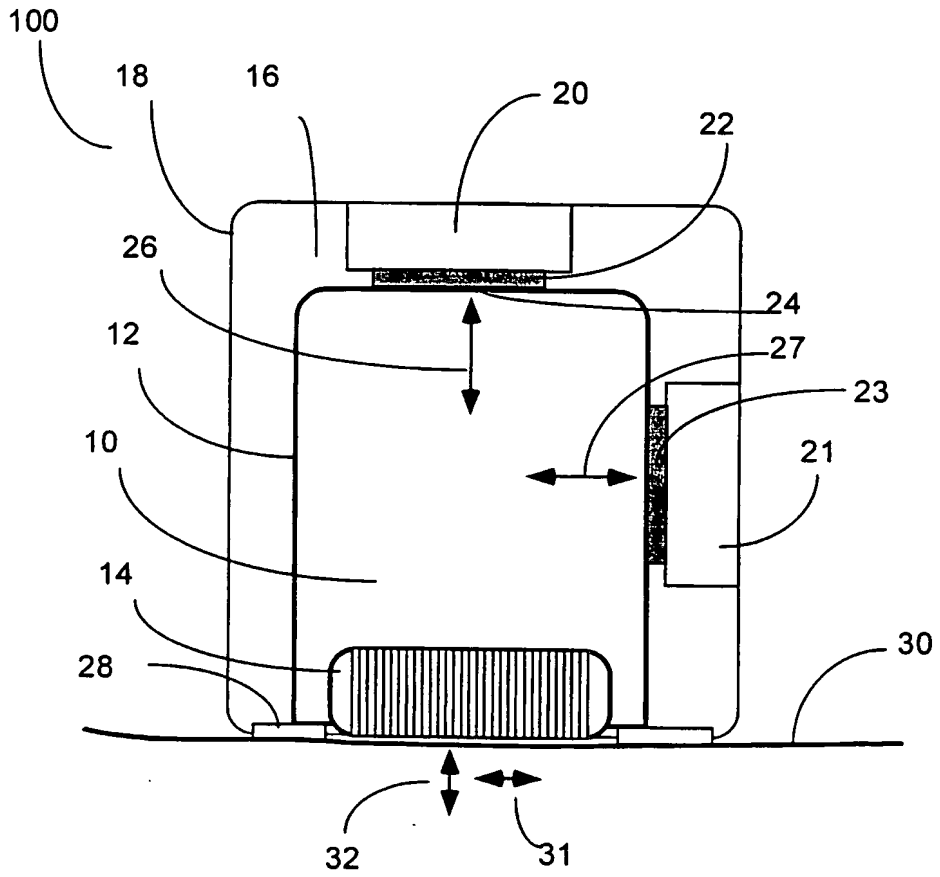


Fig 1.

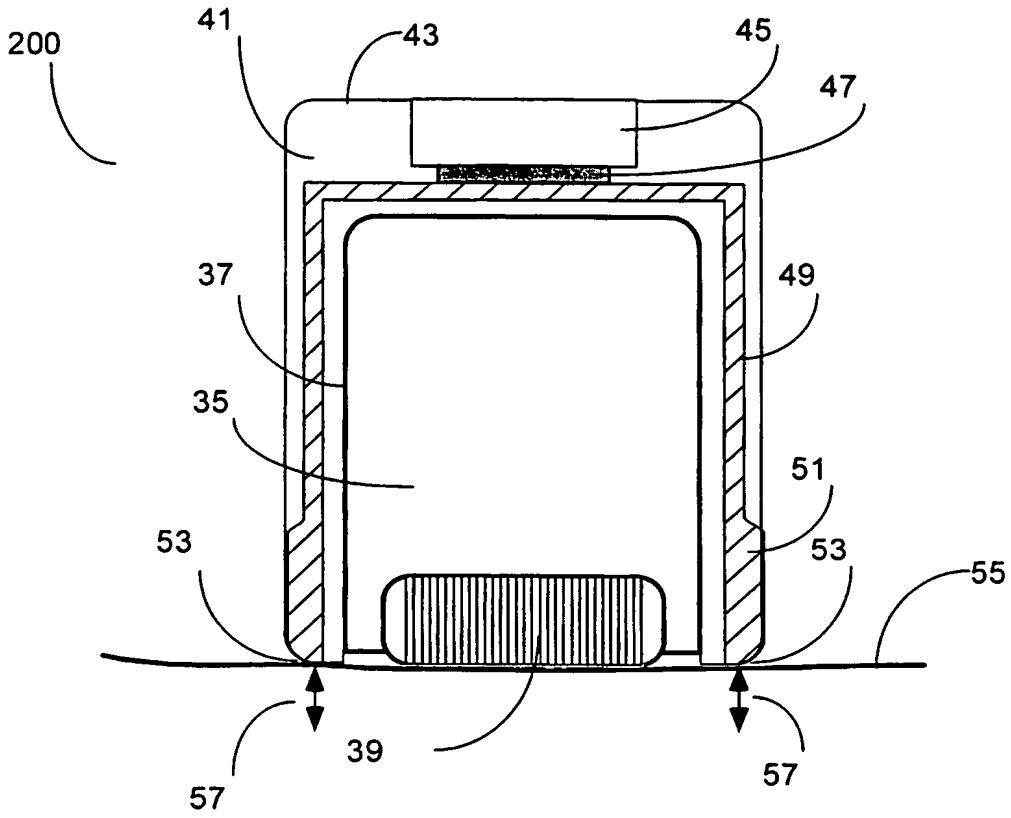


Fig 2.

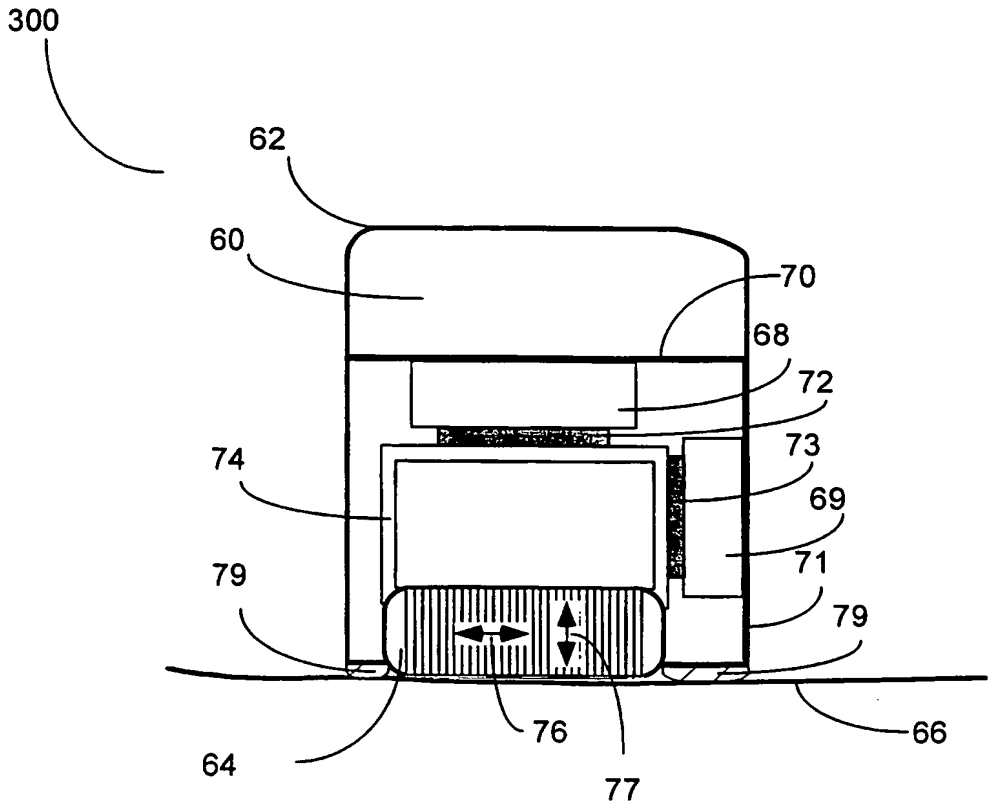


Fig 3.

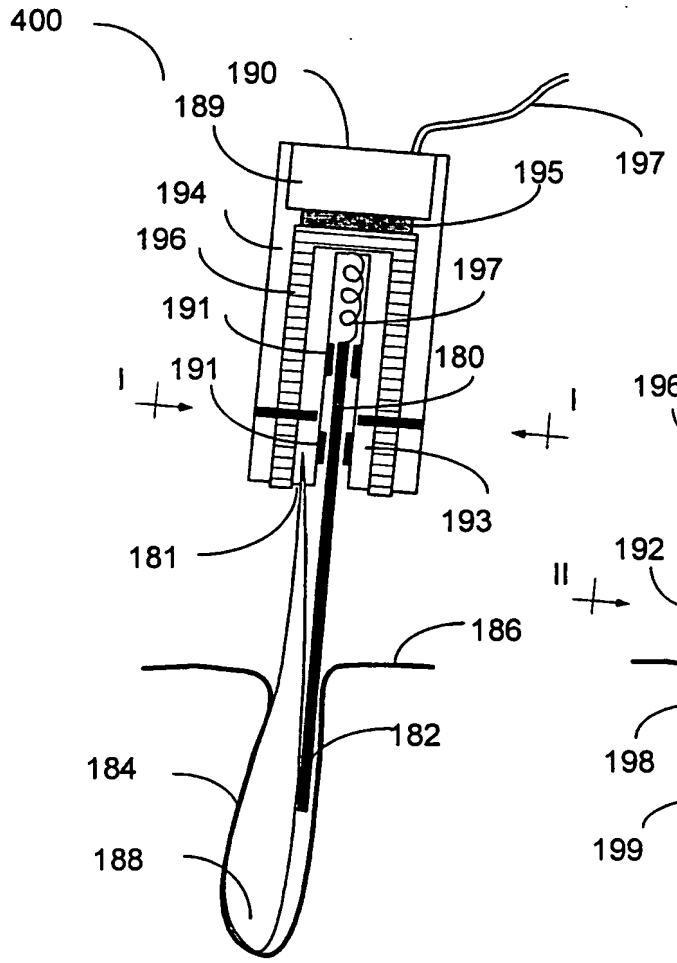


Fig.4A

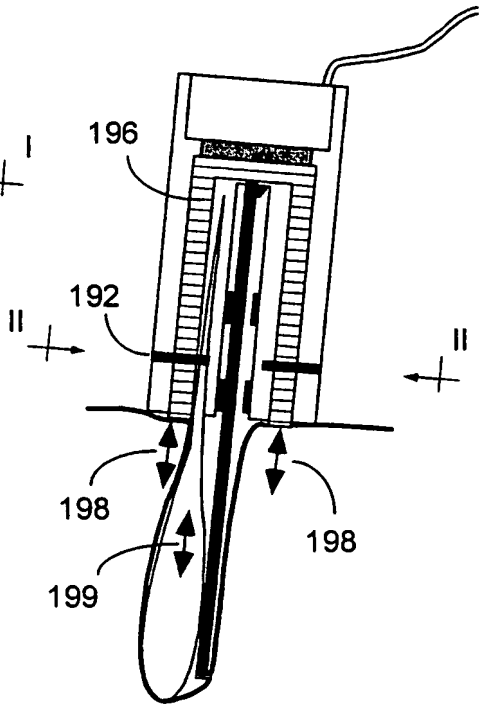


Fig 4B

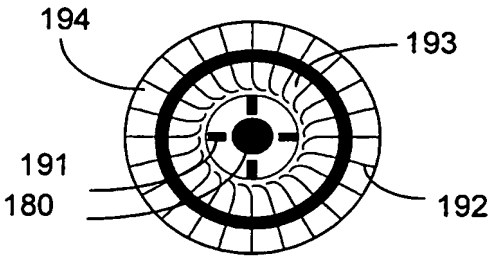


Fig4C

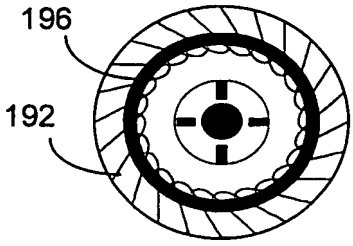


Fig4D

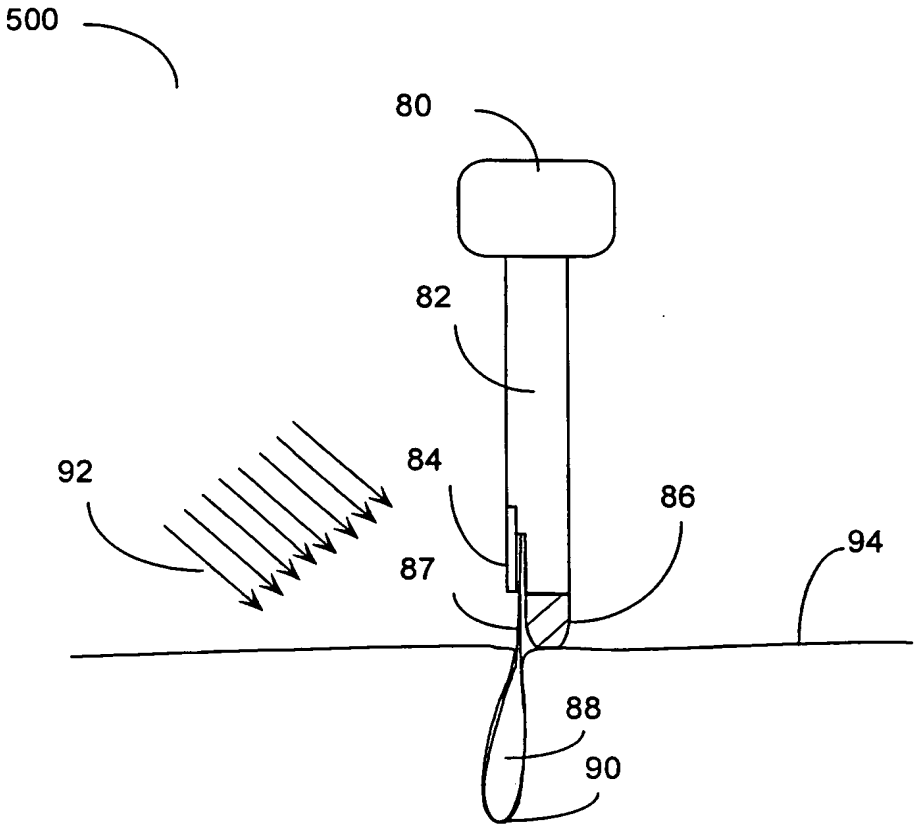


Fig 5.

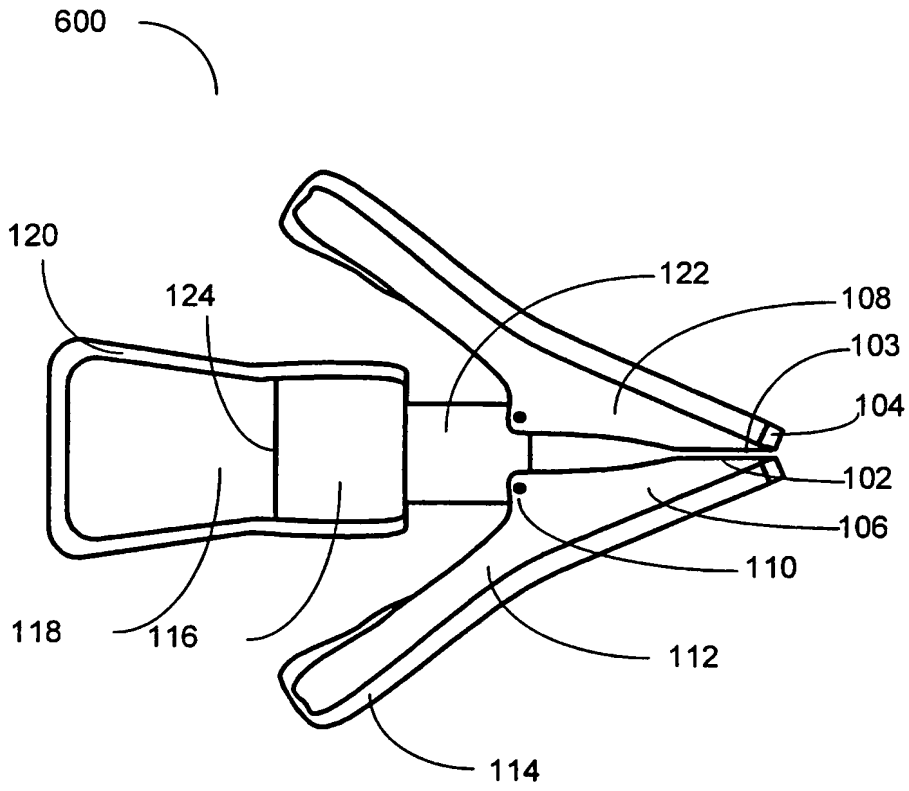


Fig. 6

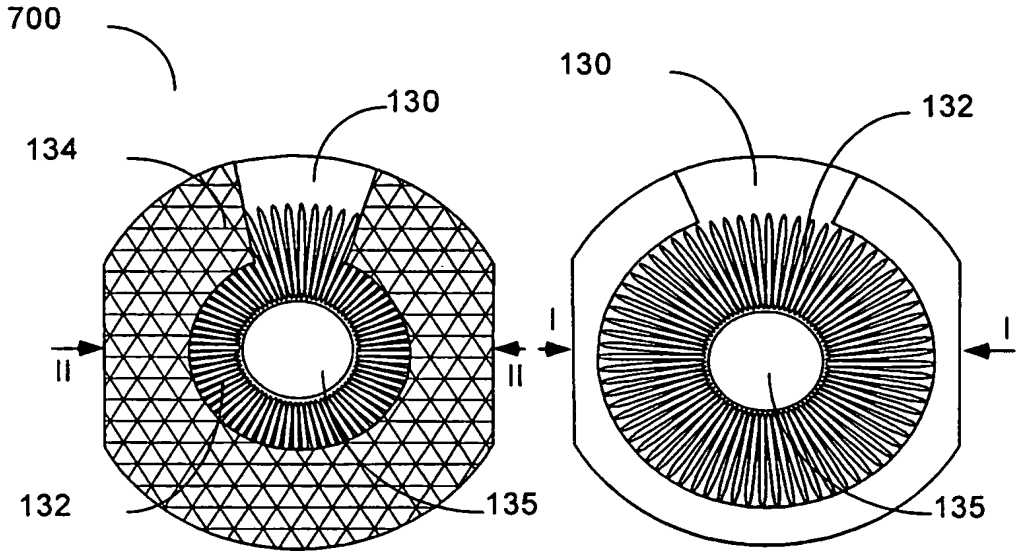


Fig.7A

Fig.7B

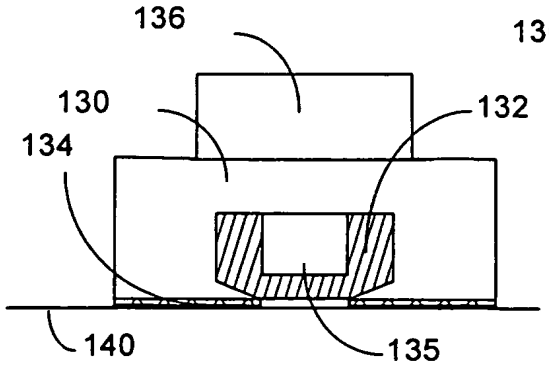


Fig.7C

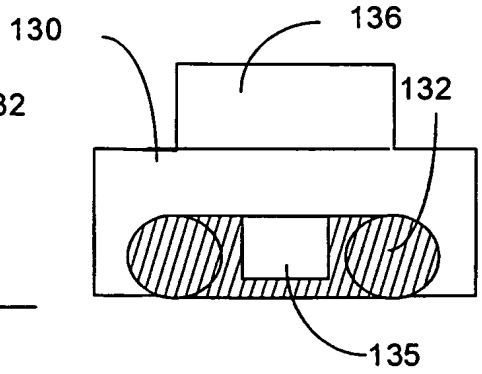


Fig.7D

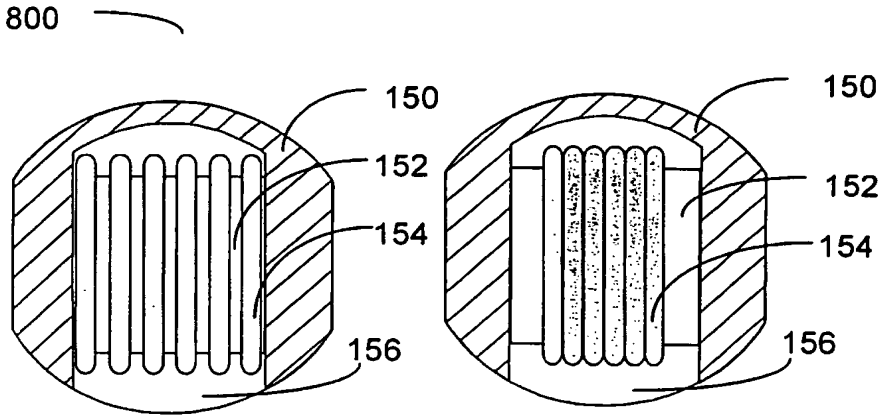


Fig. 8A

Fig. 8B

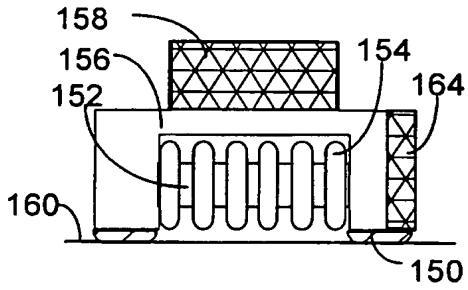


Fig. 8C

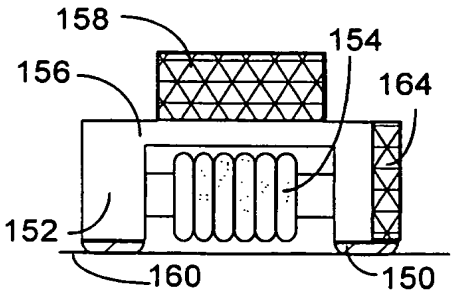


Fig. 8D

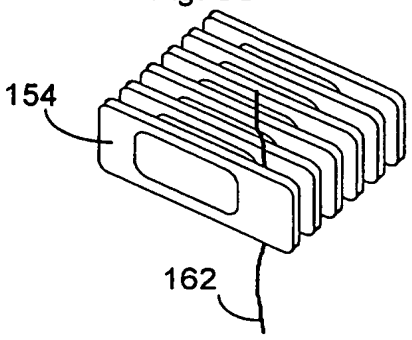


Fig. 8E

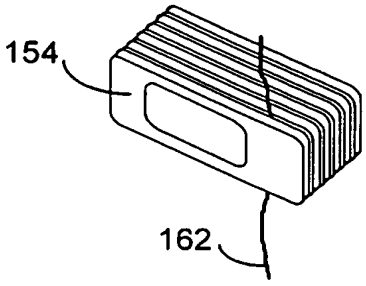


Fig. 8F

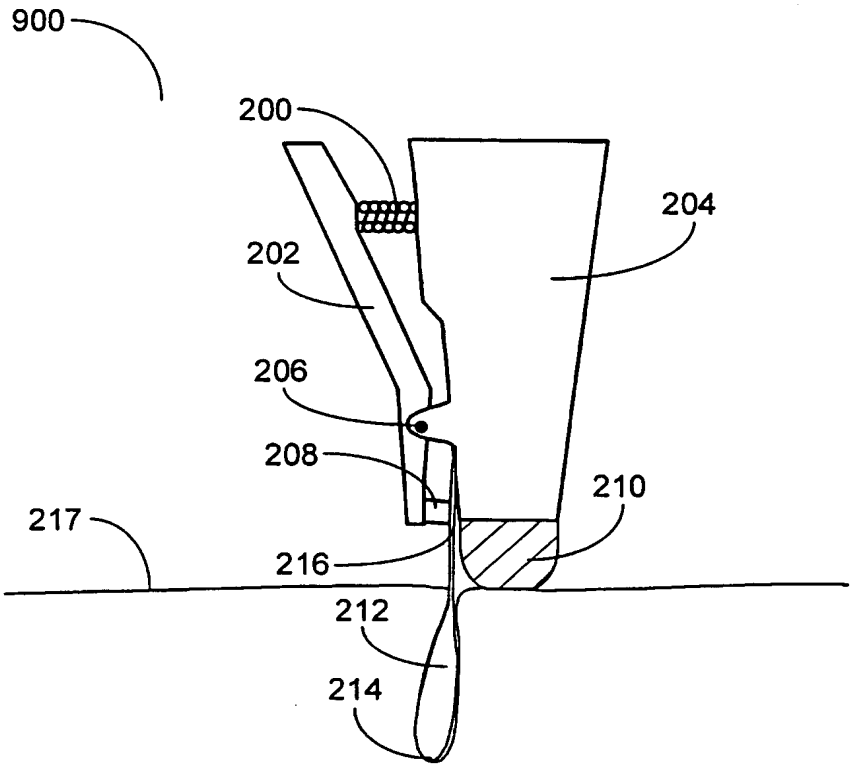


Fig. 9

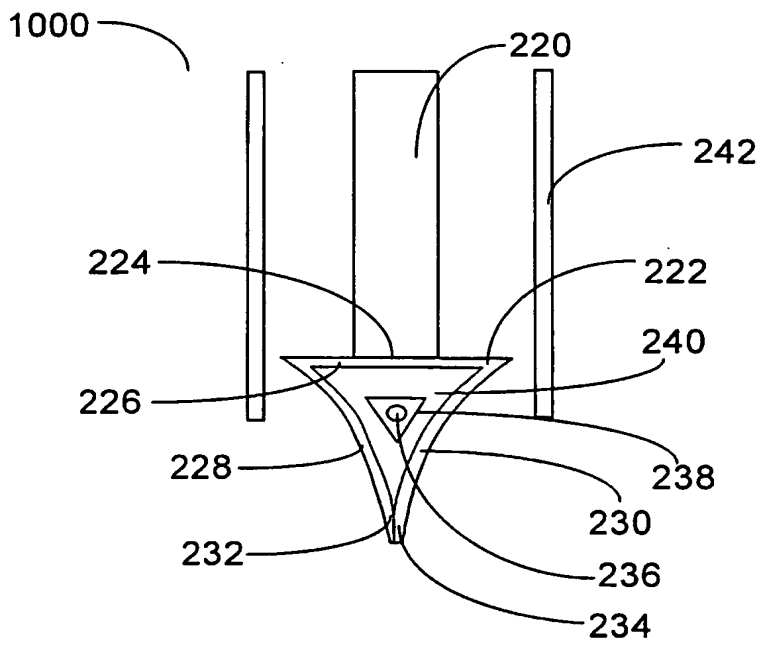


Fig.10A

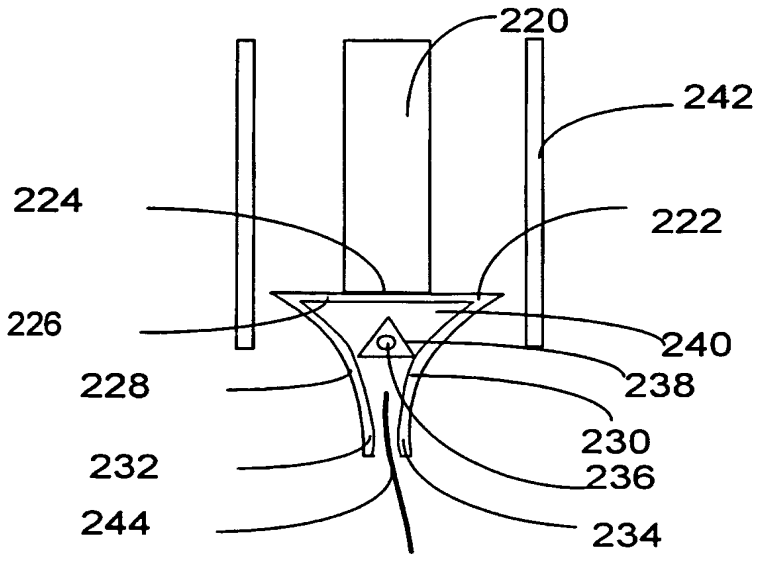


Fig.10B

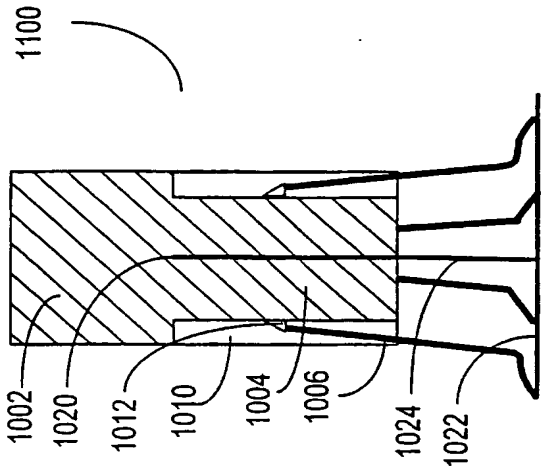


Fig.11C

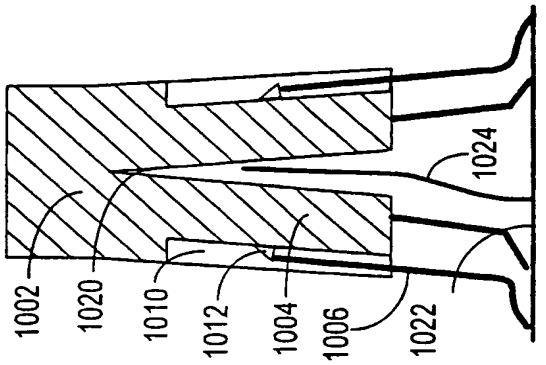


Fig.11B

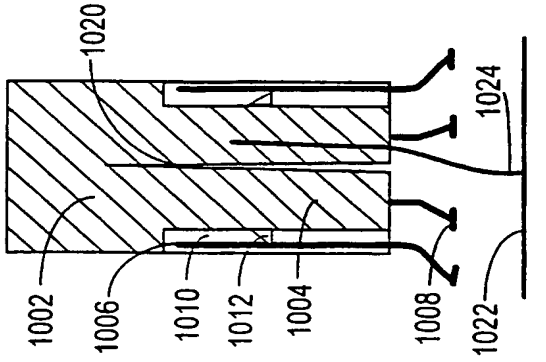


Fig.11A

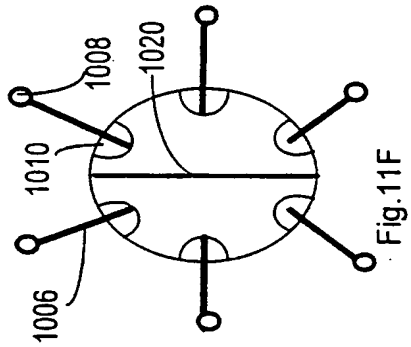


Fig.11F

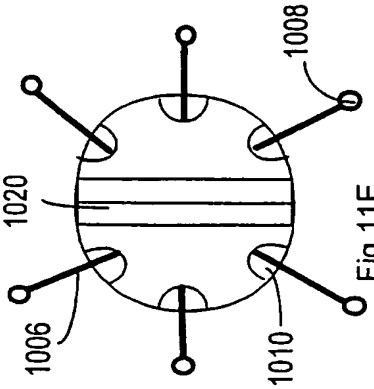


Fig.11E

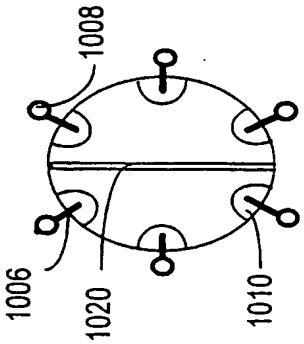


Fig.11D

INTERNATIONAL SEARCH REPORT

Int. ional Application No
PCT/IL 00/00732

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A45D26/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A45D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
PAJ, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 1996, no. 10, 31 October 1996 (1996-10-31) & JP 08 154728 A (BETAA LIFE KK), 18 June 1996 (1996-06-18) abstract ---	1-9,15, 23-30, 32-34, 40,41, 46-50, 55,56
X	PATENT ABSTRACTS OF JAPAN vol. 015, no. 048 (C-0802), 5 February 1991 (1991-02-05) & JP 02 279107 A (HOOMAA ION KENKYUSHO:KK), 15 November 1990 (1990-11-15) abstract --- -/--	1-8,15, 23-30, 32,33, 41, 46-50, 55,56

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 February 2001	05/03/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Sigwalt, C

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INTERNATIONAL SEARCH REPORT

Inte .onal Application No
PCT/IL 00/00732

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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